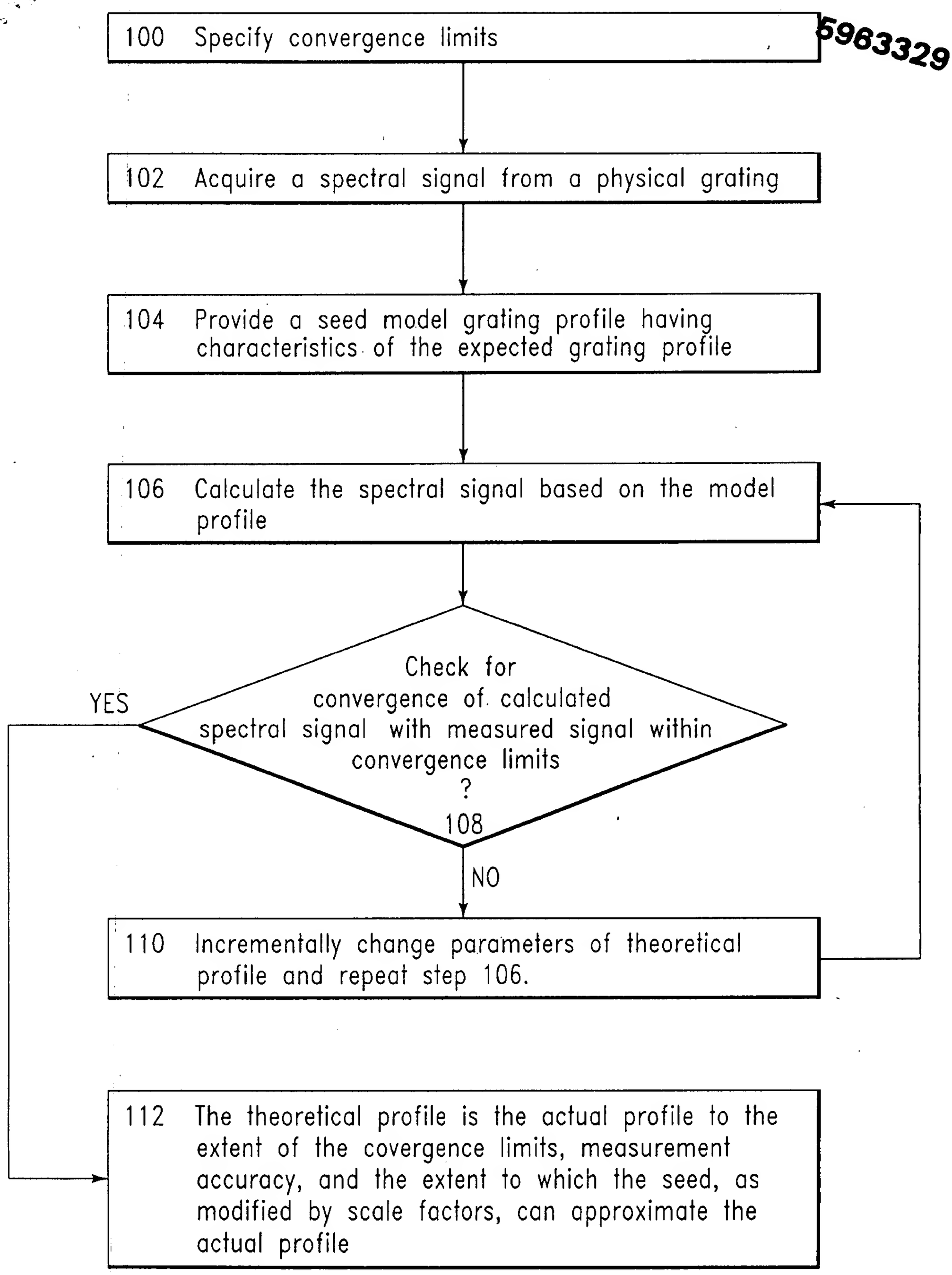

FIG. 1

25 Claims

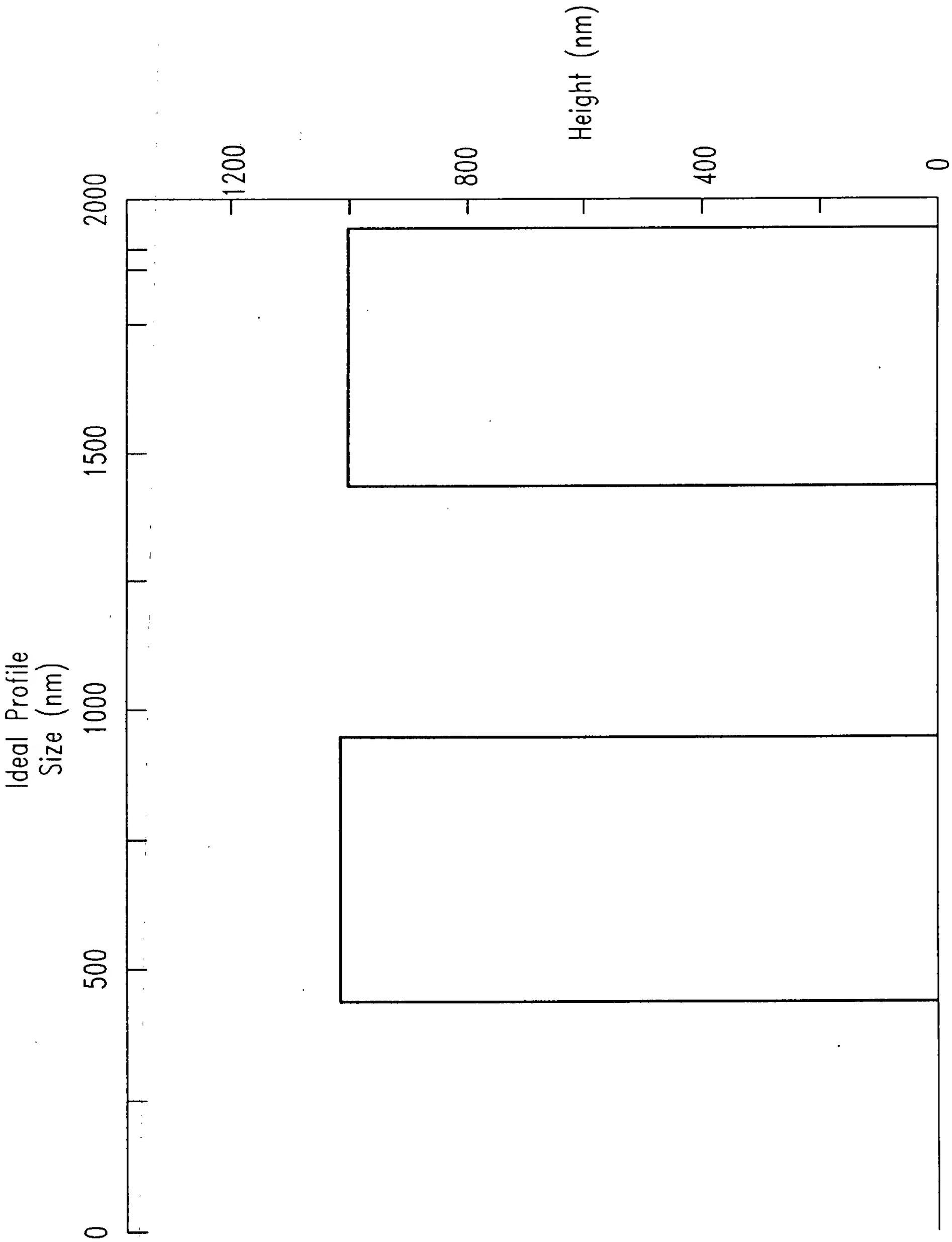

FIG. 2

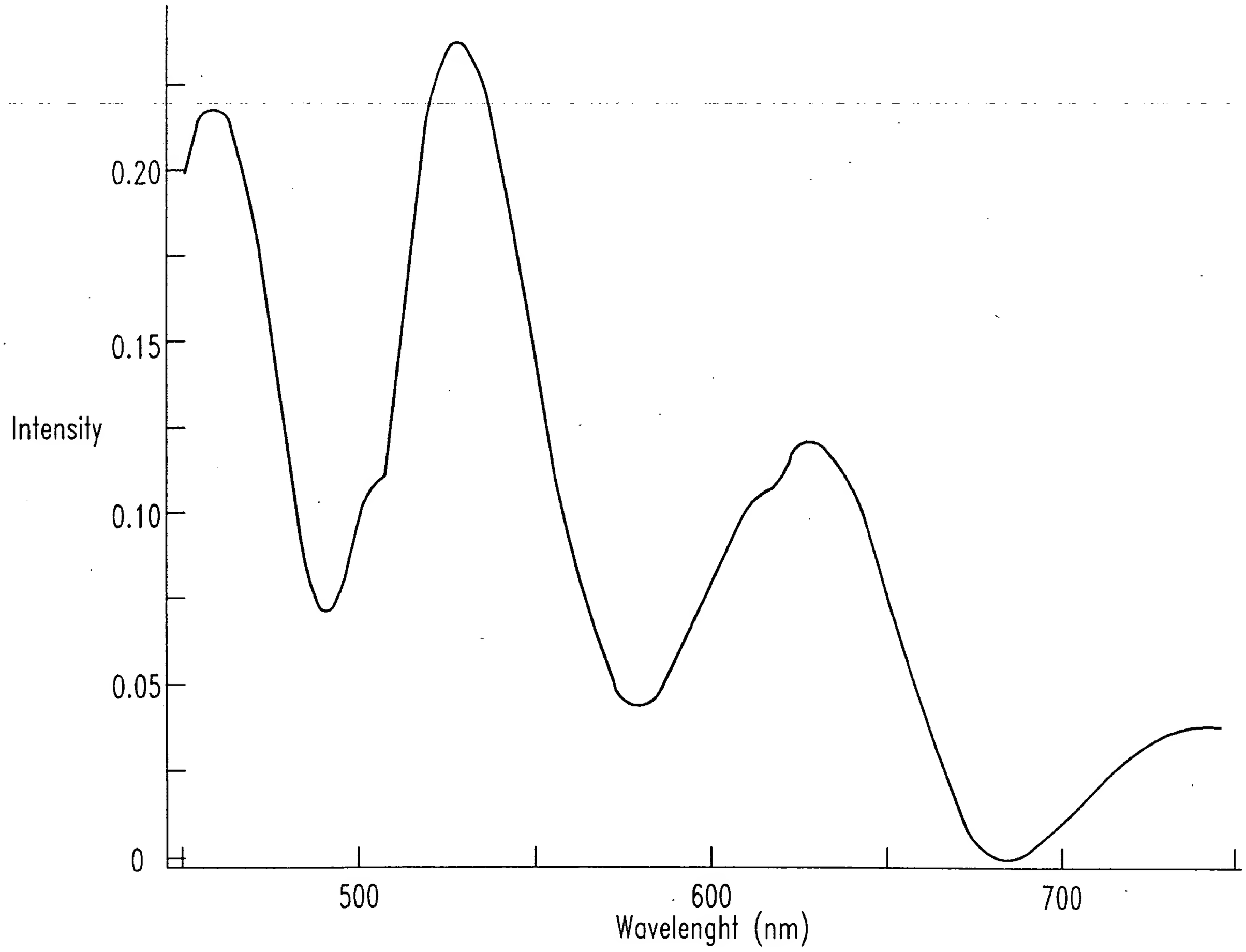

FIG. 3

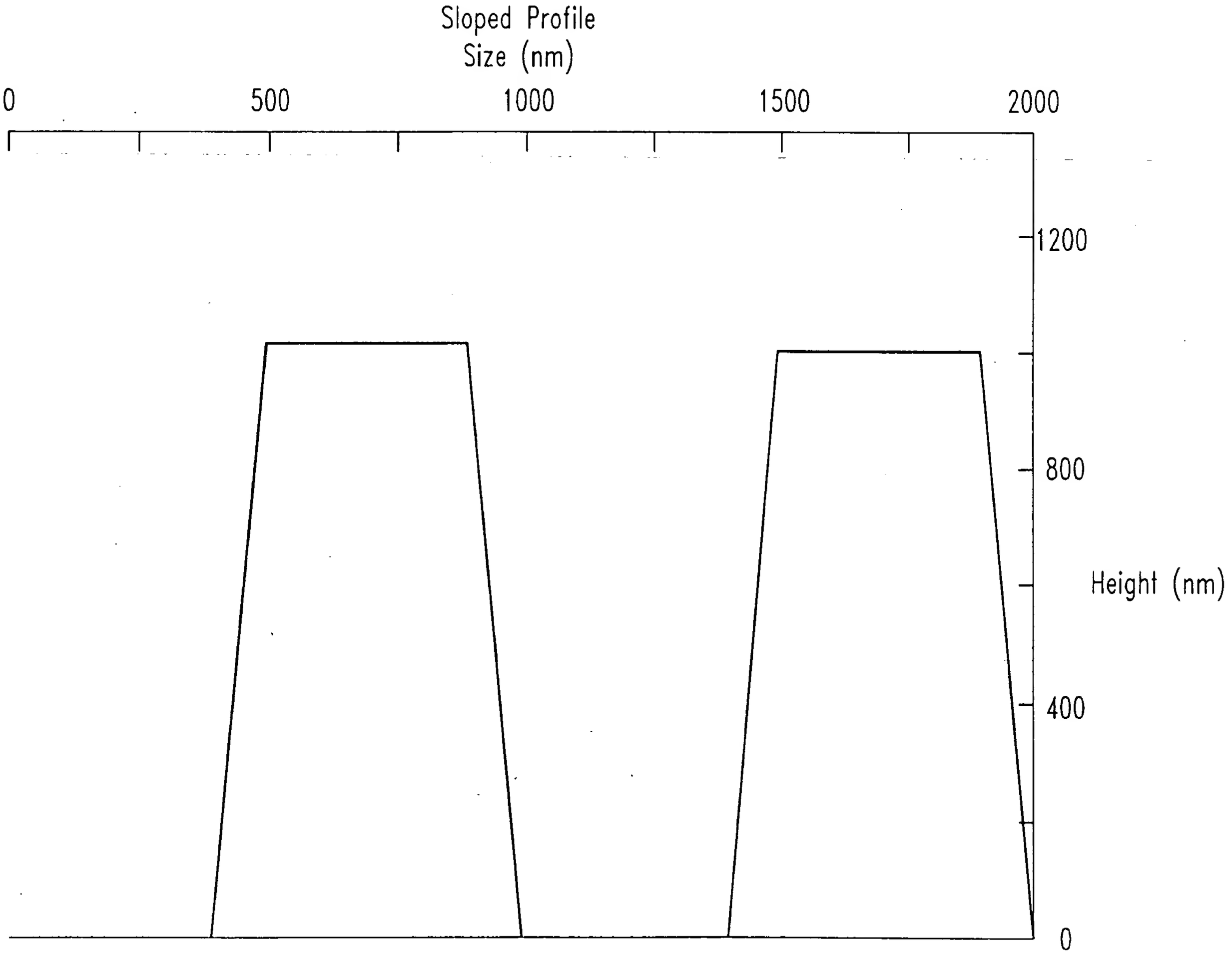

FIG. 4

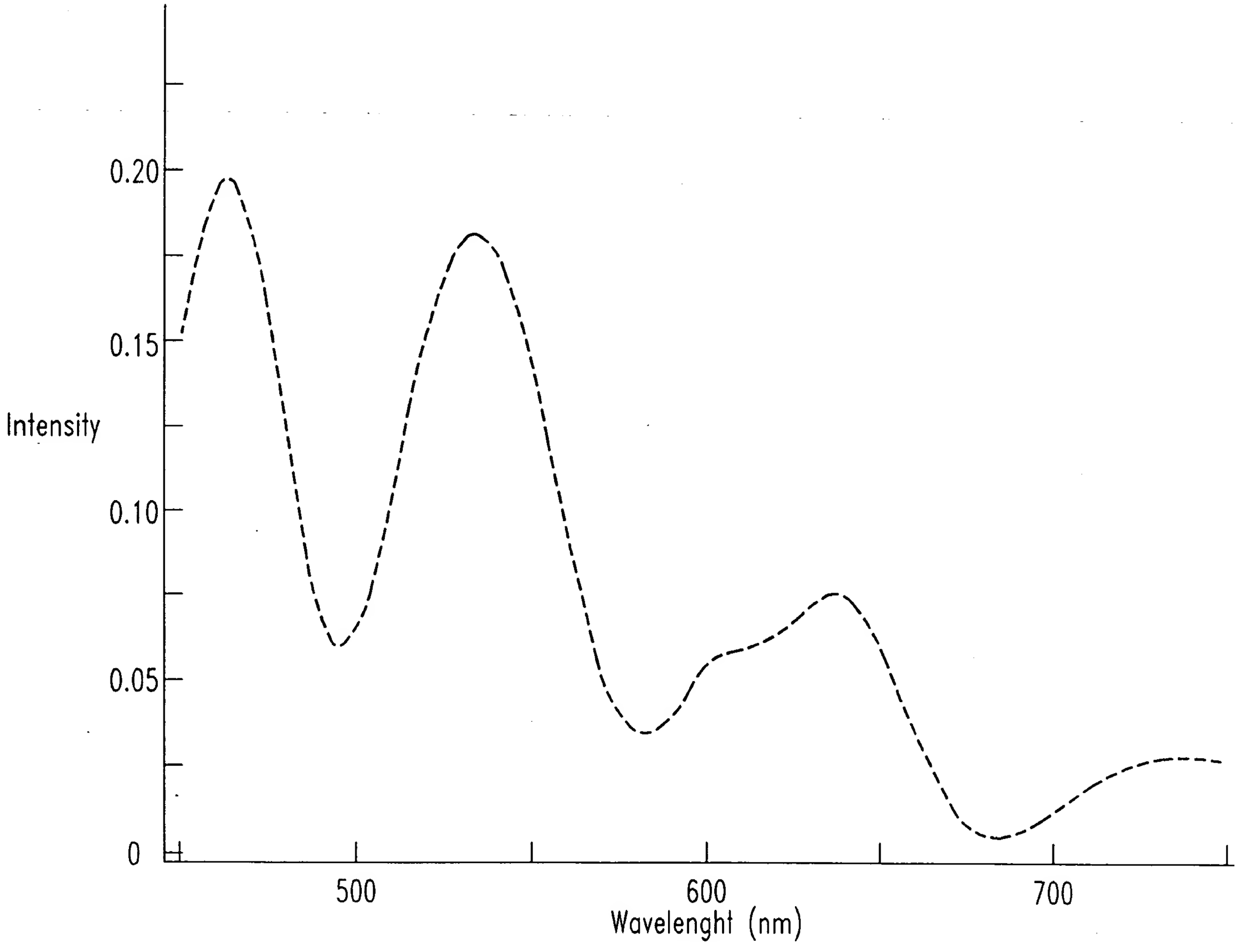

FIG. 5

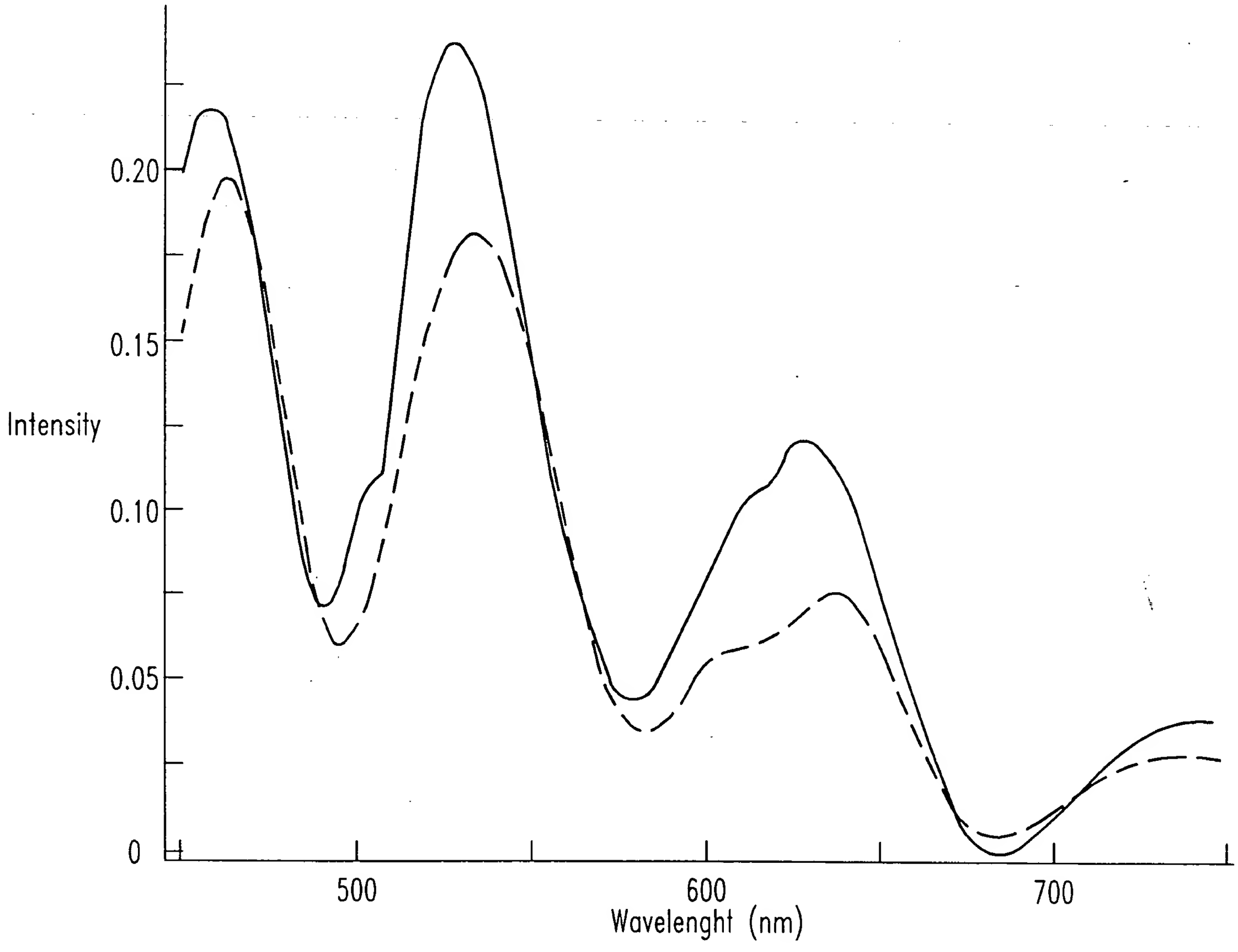

FIG. 6

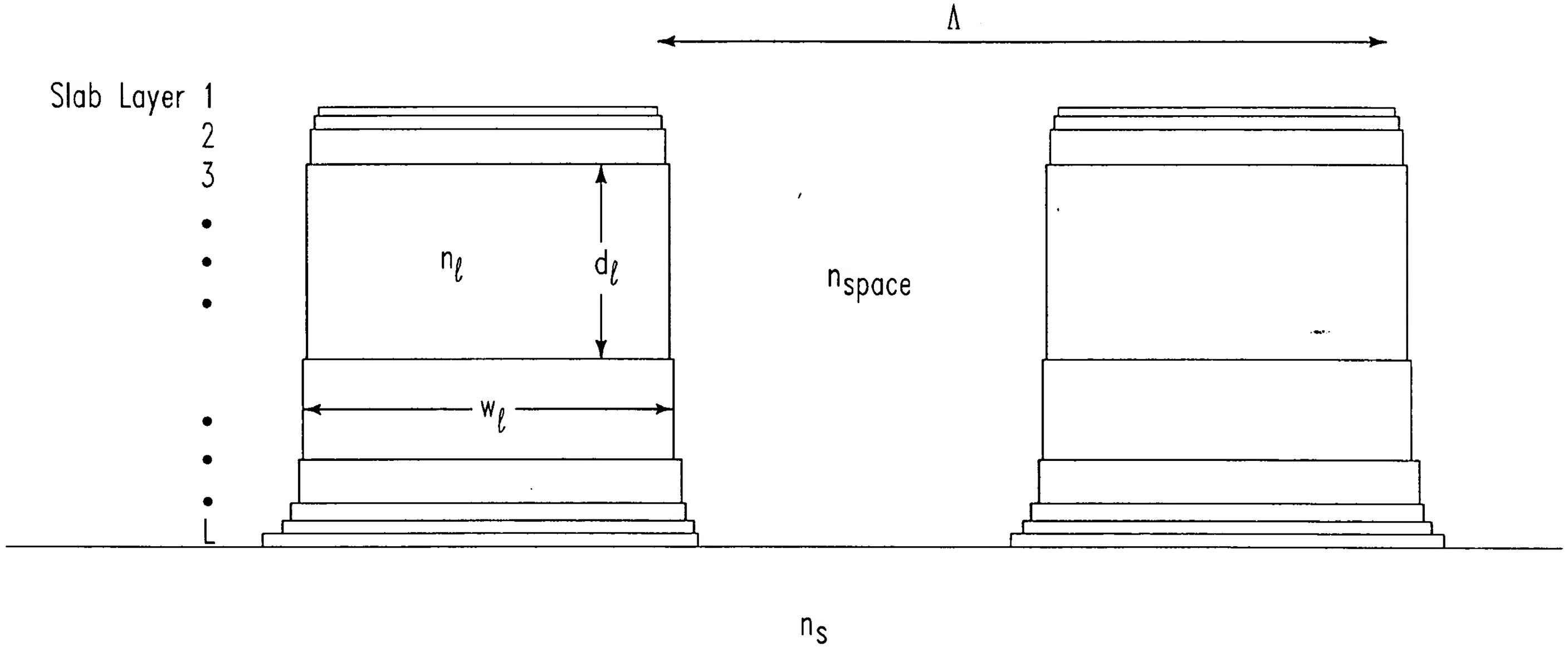

FIG. 7

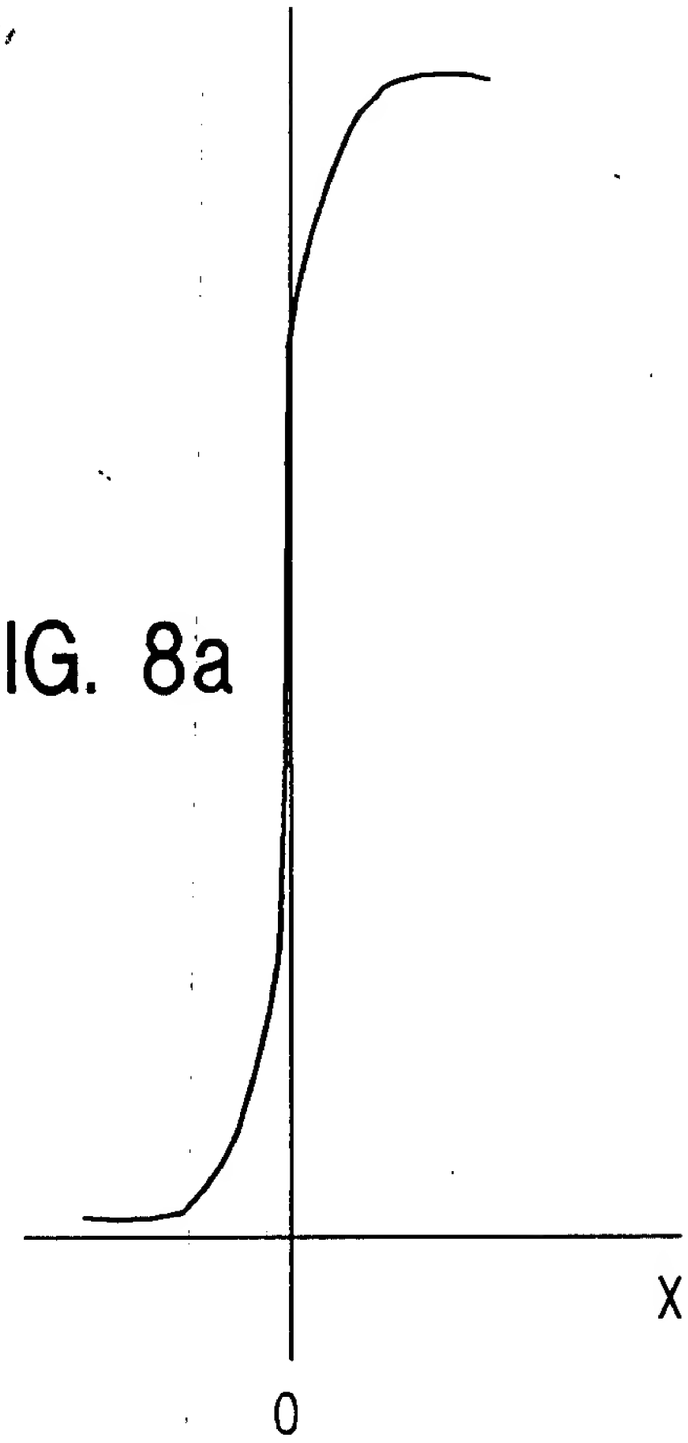

FIG. 8a

FIG. 8b

FIG. 8c

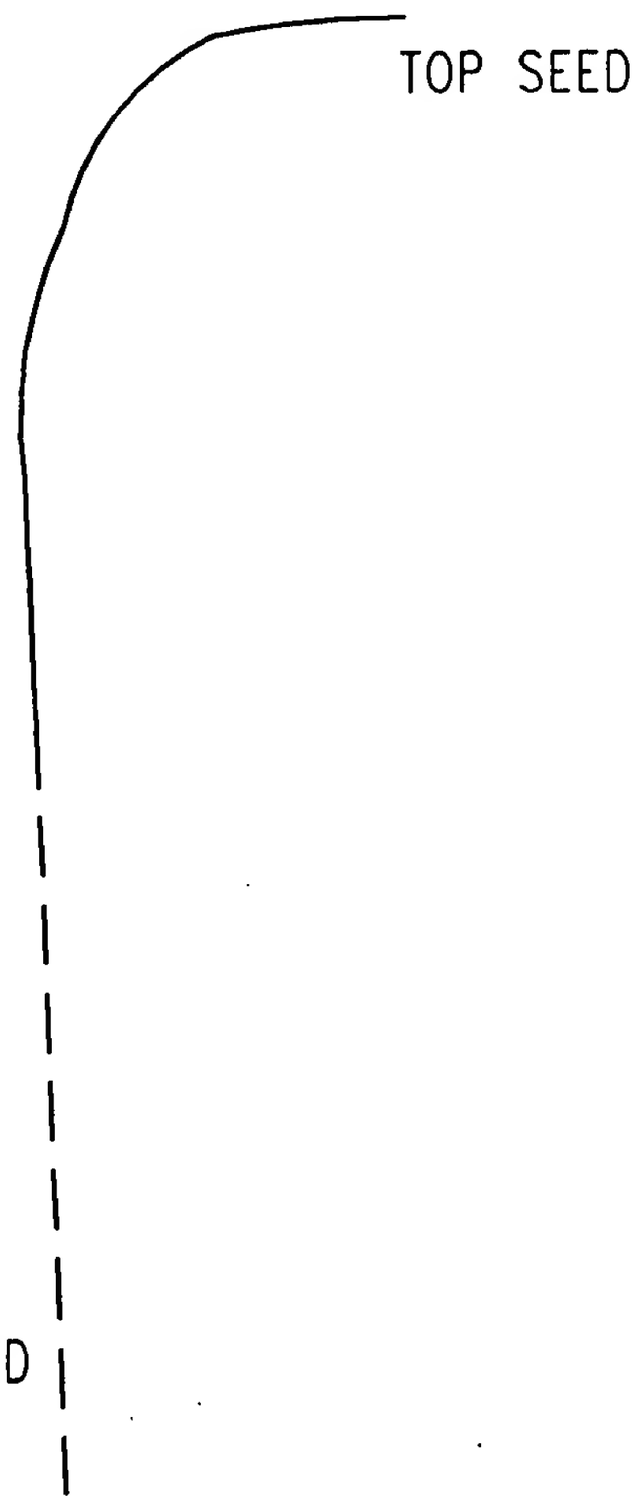

FIG. 8d

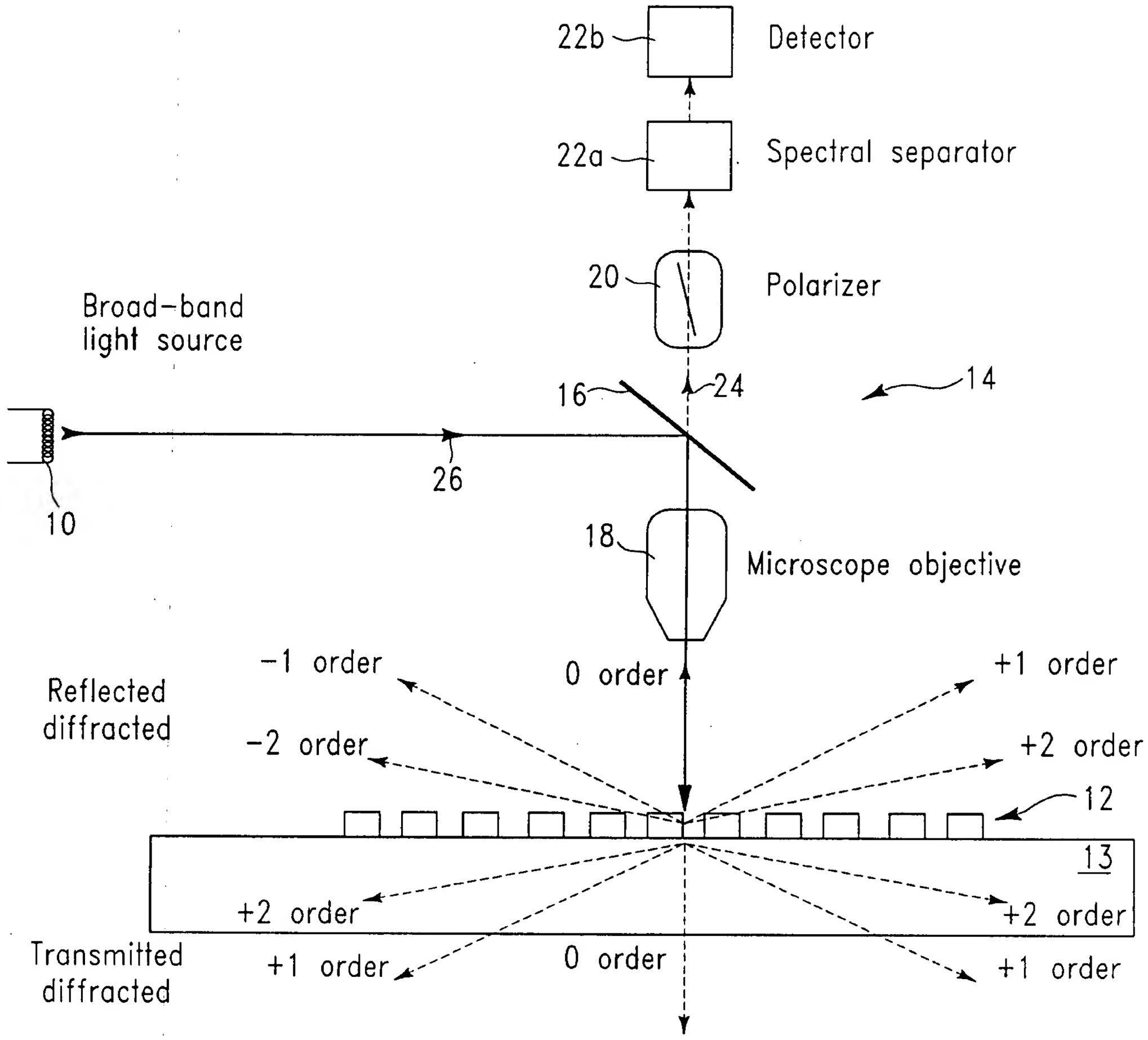

FIG. 9

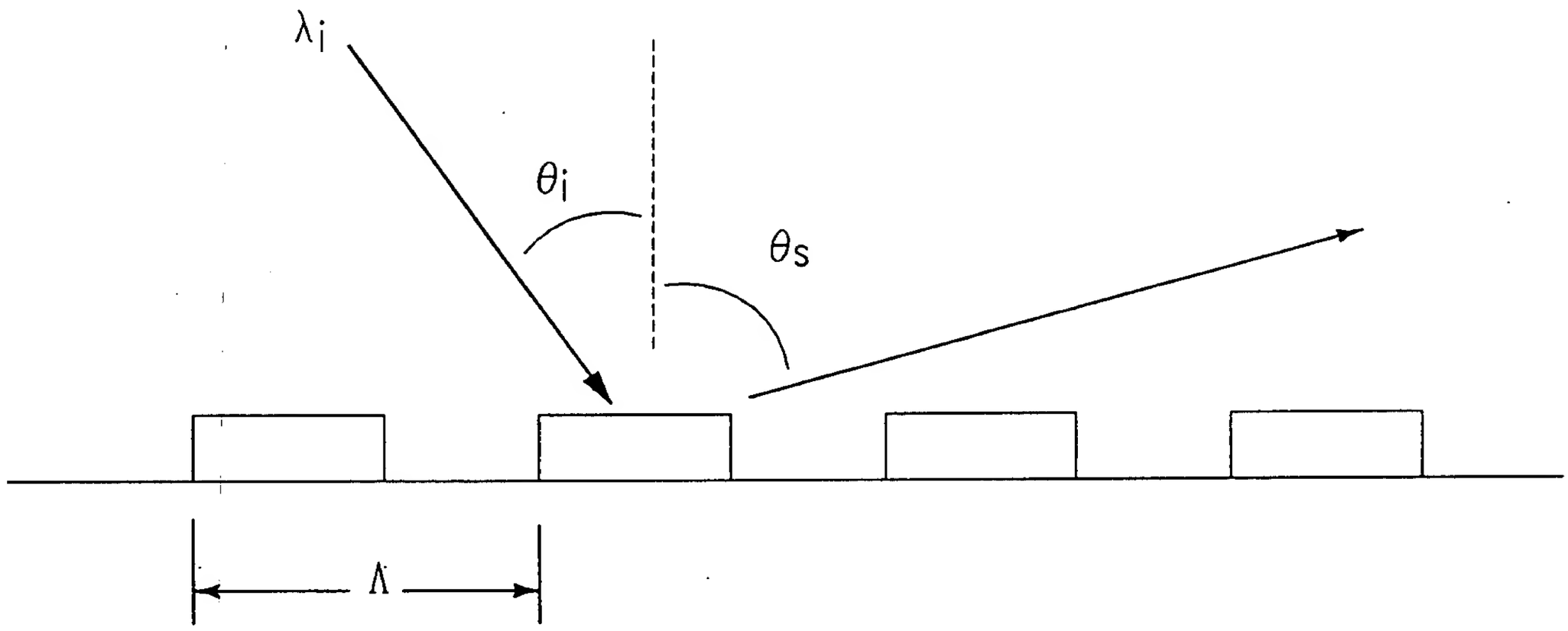

FIG. 10

FIG. 13a

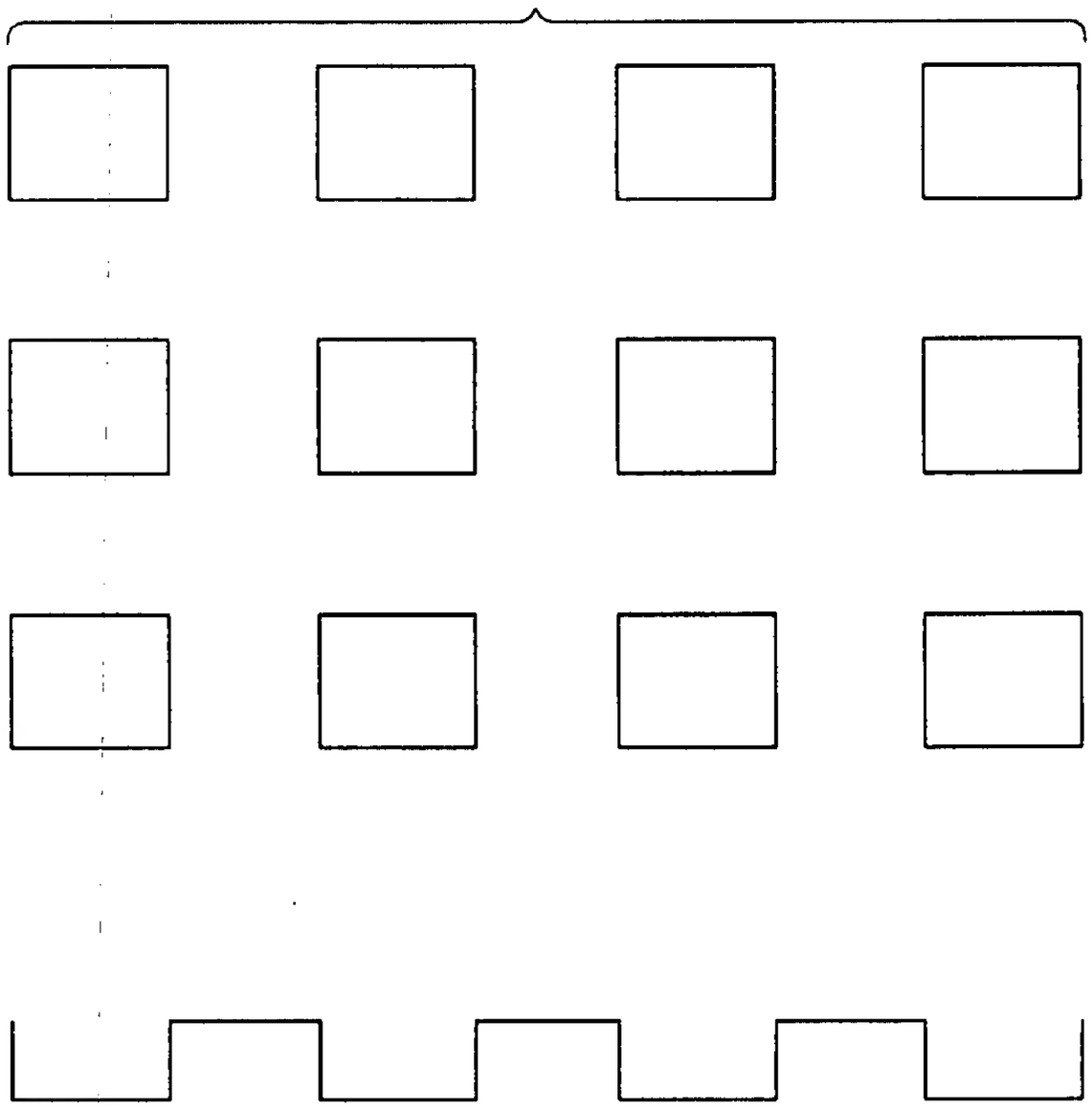

FIG. 13b

FIG. 13c

```
[0]   COUPLEDWAVE WL;TT;DD
[1]   ⍝ Set ORDERS = the number of +diffracted orders retained.
[2]   WAVELENGTH←WL
[3]   f←LAYER[;2]÷GRATINGPERIOD      ⍝ Determine f from dimensions
[4]   d←LAYER[;3]                    ⍝ Layer thicknesses
[5]   n0←1                           ⍝ Index of air
[6]   THETA←TH                       ⍝ Angle of incidence, degrees
[7]   THET←THETA×○1÷180              ⍝ Incidence angle, radians
[8]   ns←SIINDEX WAVELENGTH          ⍝ Determine the substrate index
[9]   n←0⍴0
[10]  FILMINDEX¨LAYER[;1]            ⍝ Determine the FILM index
[11]  N←1+ORDERS×2                   ⍝ N will always be odd
[12]  h←(⍳N)-1                       ⍝ h is  0 1 2 3 4 5 6 7...
[13]  i←h-((N-1)÷2)                  ⍝ i is  ...¯3 ¯2 ¯1 0 1 2 3...
[14]  I←,DD←(N,N)⍴0
[15]  TT←(N,N)⍴⍳N
[16]  I[(0=,(TT-⍉TT))/⍳N*2]←1
[17]  I←(⍴f)⍴⊂(⍴DD)⍴I               ⍝ I is the identity matrix
[18]  IL←1⊃I
[19]  k0←○2÷WAVELENGTH
[20]  kxi←k0×(n0×1○THET)-i×WAVELENGTH÷GRATINGPERIOD
[21]  k1zi←((-(TT<0)×2)+1)×(TT←((k0*2)×(n0*2))-(kxi*2))*.5
[22]  k2zi←(((k0*2)×(ns*2))-(kxi*2))*.5        ⍝ Absorbing substrate (Si)
[23]  TM:
[24]  B←((K+.×¨(EE←⊞¨E←PERMITTIVITY))+.×¨K←WAVENUMBER)-¨I
[25]  ⍝DERTM←0
[26]  ⍝→TE
[27]  EIGENSTUFF E+.×¨B              ⍝ TM eigenspace calculations
[28]  V←(EE+.×¨W)+.×¨Q               ⍝ PRODUCT MATRIX FOR   TM  (EE IS ⊞¨E)
[29]  X←I×¨*-k0×¨Q×d                 ⍝ d SCALAR OR VECTOR WITH LENGTH OF f
[30]  DELTA←((2×N),1)⍴(i=0),((2○THET)×0J1÷n0)×i=0      ⍝ FOR TM
[31]  Z1←(1⊃I)×(N,N)⍴k1zi÷((n0*2)×k0)
[32]  Z2←(1⊃I)×(N,N)⍴k2zi÷((ns*2)×k0)
[33]  M1←IL,[1]-0J1×Z1
[34]  FG←(1⊃I),[1]0J1×Z2
[35]  FANDG¨⌽⍳⍴f
[36]  R←N↑,(-DELTA)⊞(M1,-FG)
[37]  ⍝      Diffraction efficiency for TM
[38]  DERTM←(THETAOUT=TH)/(DERTM=0)/DERTM←(R×+R)×9○(k1zi÷k0×n0×2○THET)
[39]  ⍝ DERTM←(DERTM=0)/DERTM←(R×+R)×9○(k1zi÷k0×n0×2○THET)
[40]  ⍝
[41]  DERTE←0
[42]  →COMB
[43]  TE:
```

FIG. 11a

```
[44]  A←(K+.×¨K)-¨E
[45]  EIGENSTUFF A                    ⍝ TE eigenspace calculations
[46]  V←W+.×Z¨Q                       ⍝ PRODUCT MATRIX FOR   TE
[47]  X←I×¨*-k0×¨Q×d                  ⍝ d SCALAR OR VECTOR WITH LENGTH OF f
[48]  DELTA←((2×N),1)⍴(i=0),((2○THET)×0J1×n0)×i=0          ⍝ FOR TE
[49]  Y1←(1⊃I)×(N,N)⍴k1zi÷k0
[50]  Y2←(1⊃I)×(N,N)⍴k2zi÷k0
[51]  M1←IL,[1]-0J1×Y1
[52]  FG←(1⊃I),[1]0J1×Y2
[53]  FANDG¨Φ⍳⍴f
[54]  R←N↑,(-DELTA)⌹(M1,-FG)
[55] ⍝          Diffraction efficiency for TE
[56]  DERTE←(THETAOUT=TH)/(DERTE≠0)/DERTE←(R×+R)×9○(k1zi÷k0×n0×2○THET)
[57] COMB:
[58]  CURVE←CURVE,[1]1 3⍴WAVELENGTH,DERTE,DERTM
[59] ⍝CURVE←CURVE,[1]1 3⍴WAVELENGTH,DERTM,DERTE

[0]   EIGENSTUFF EI
[1]   Z←EIGEN¨EI          ⍝ The function EIGEN is an IBM program product
[2]   W←((⍴f)⍴⊂1 0)↓¨Z    ⍝ and cannot be shown here.
[3]   QQ←((⍴f)⍴⊂((-N),0))↓¨Z
[4]   Q←0⍴0
[5]   EIGENVALUE¨QQ
[6]   Q←Q×¨I

[0]   EIGENVALUE QQ
[1]   Q←Q,⊂(N,N)⍴QQ*.5

[0]   FANDG L;XA;XL;WL;VL
[1]   XL←L⊃X
[2]   WL←L⊃W
[3]   VL←L⊃V
[4]   AB←(⌹((-WL),[1]VL),FG)+.×(WL+.×XL),[1]VL+.×XL
[6]   A←(N,N)⍴AB
[7]   FG←(WL+.×IL+XA),[1]VL+.×IL-XA←XL+.×A

[0]   FILMINDEX FILM;C1;C2;C3;I
[1]   I←(20=+/¨((⊂FILM)=CAUCHY[;1]))/⍳1↑⍴CAUCHY
[2]   C1←CAUCHY[I;2]
[3]   C2←CAUCHY[I;3]
[4]   C3←CAUCHY[I;4]
[5]   n←n,C1+(C2÷(WAVELENGTH×10)*2)+C3÷(WAVELENGTH×10)*4
```

FIG. 11b

```
[0]   E←PERMITTIVITY
[1]   E←0ρ0
[2]   PERMPRIME¨ιρf
```

```
[0]   PERMPRIME M
[1]   PP←(N,N)ρh+1
[2]   II←⍳PP
[3]   EE←,((n[M]*2)-(n0*2))×(10(o1×(II-PP)×f[M]))÷o1×II-PP
[4]   EE[(0=,(II-PP))/ιN*2]←((n[M]*2)×f[M])+(n0*2)×(1-f[M])
[5]   E←E,⊂(ρII)ρEE
```

```
[0]   K←WAVENUMBER
[1]   K←(N,N)ρkxi÷k0
[2]   K←(⊂K)×¨I
```

```
[0]   ns←SIINDEX WAVELENGTH;INDEX;A;ks
[1]  ⍝ Determine the complex refractive index from 210 to 825 nm.
[2]   INDEX←¯1+2↑(WAVELENGTH≤SI[;1])/ι1↑ρSI
[3]   ns←SI[INDEX[1];2]+(A←(WAVELENGTH-SI[INDEX[1];1])÷-/SI[INDEX;1])
×-/SI[INDEX;2]
[5]   ks←SI[INDEX[1];3]+A×-/SI[INDEX;3]
[6]   ns←ns-0J1×ks
```

FIG. 11c

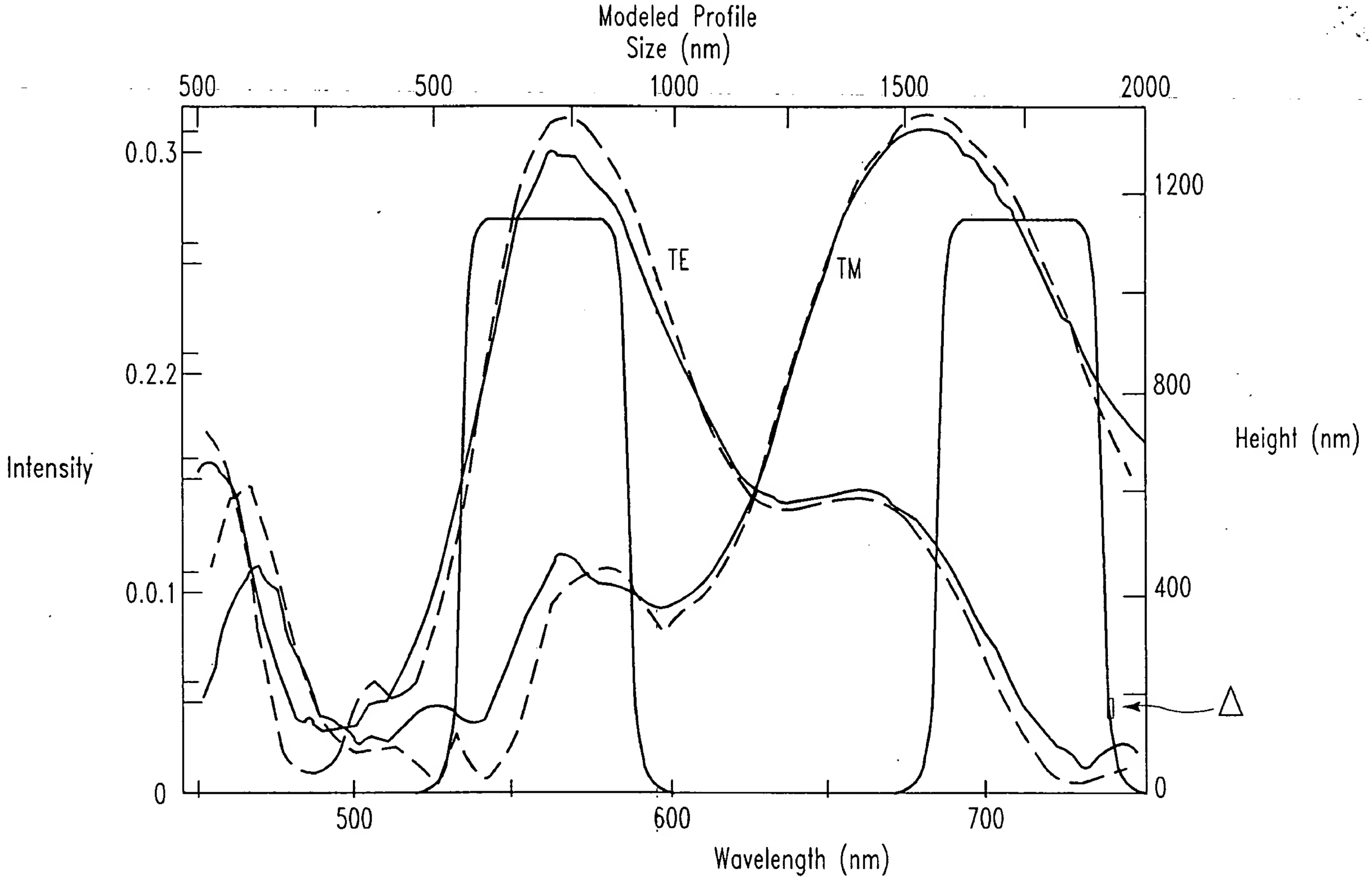

FIG. 12

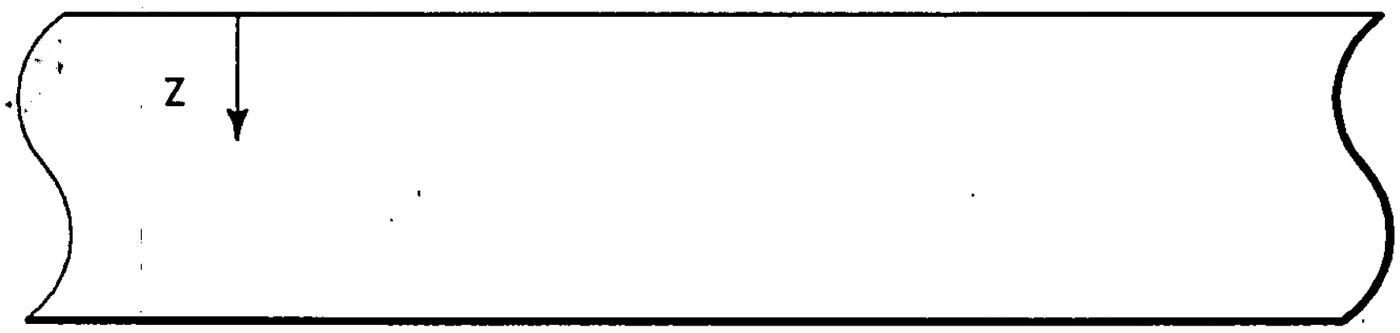

FIG. 14a

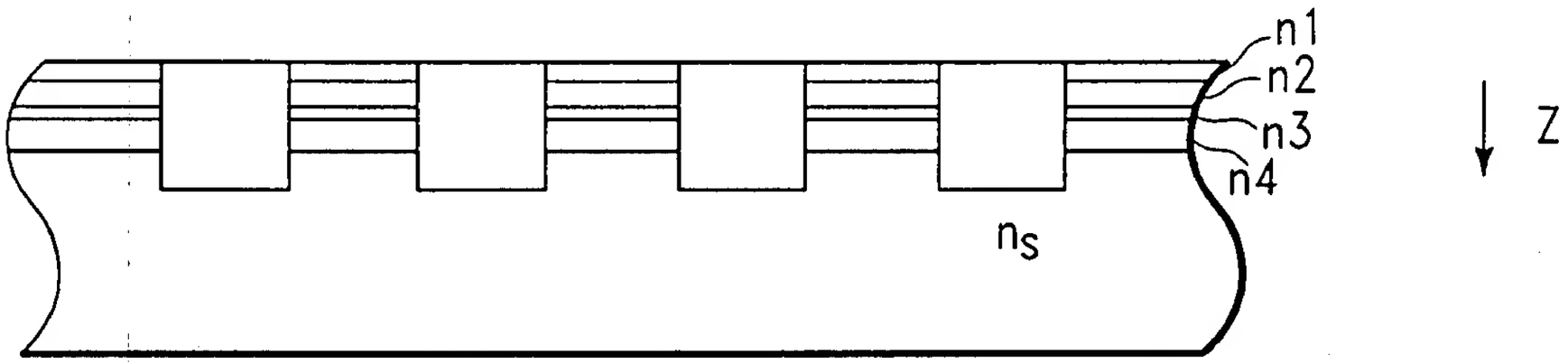

FIG. 14b

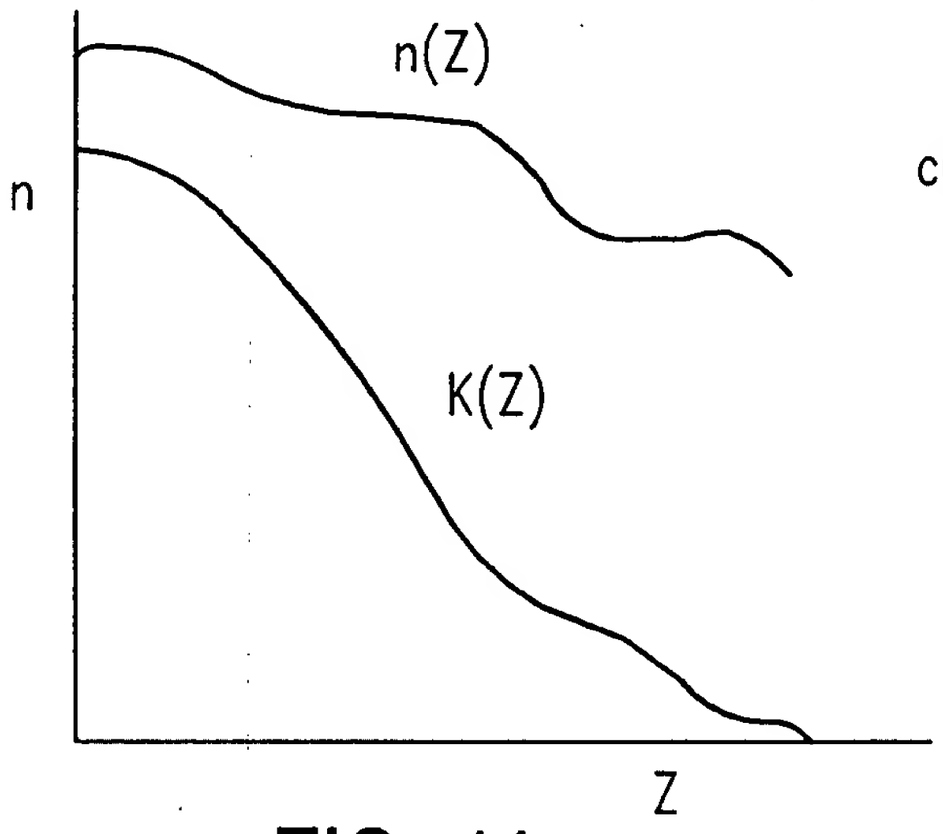

FIG. 14c

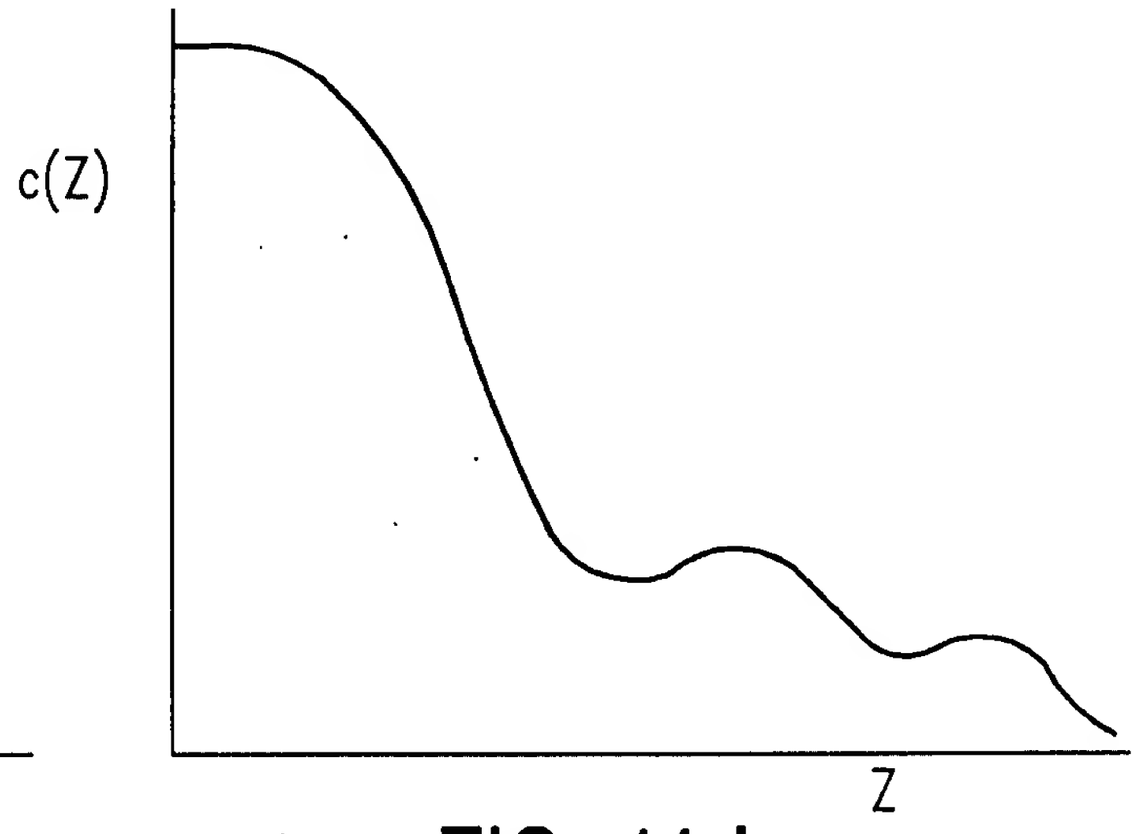

FIG. 14d

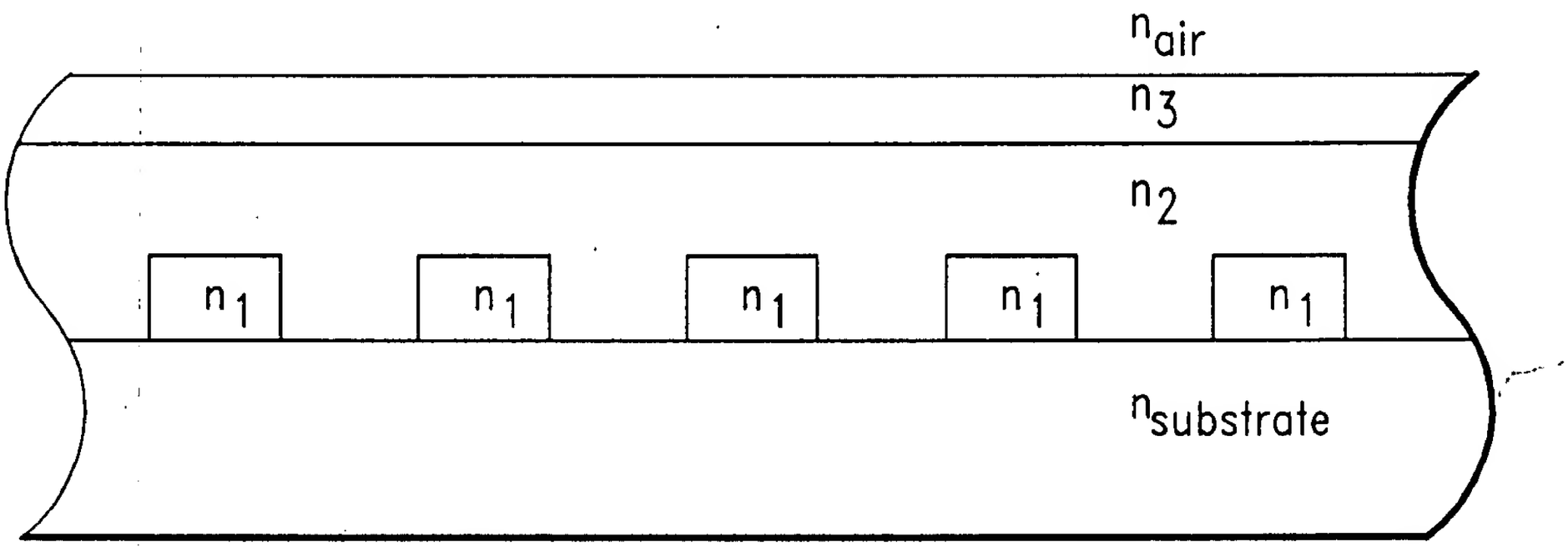

FIG. 15